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才云科技

TensorFlow实现深度学习简介

郑泽宇
才云科技　首席科学家

自我介绍

竞赛金牌

优秀毕业生
十佳论文

西贝尔奖学金

谷歌电商

Co-founder
首席科学家

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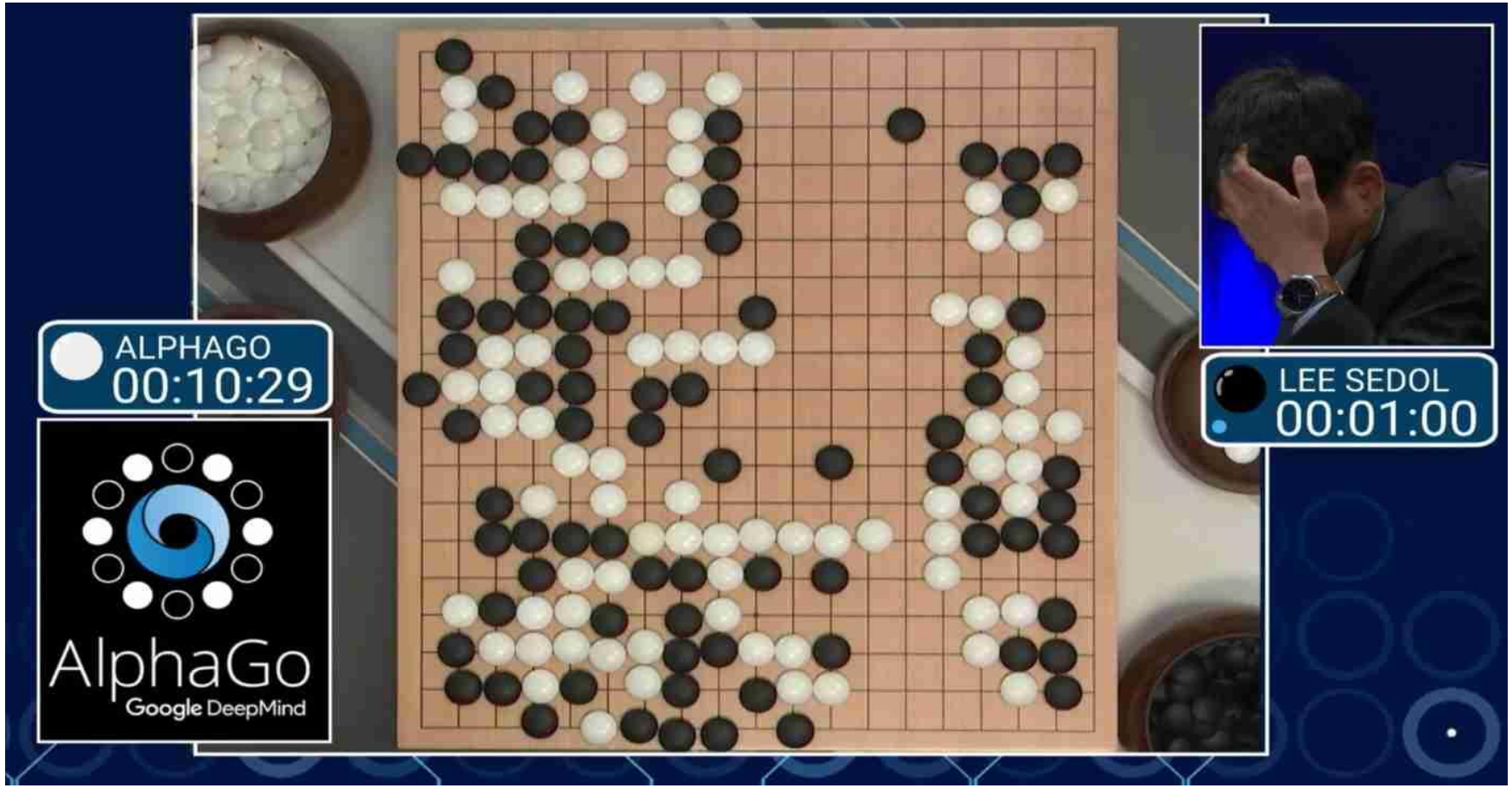
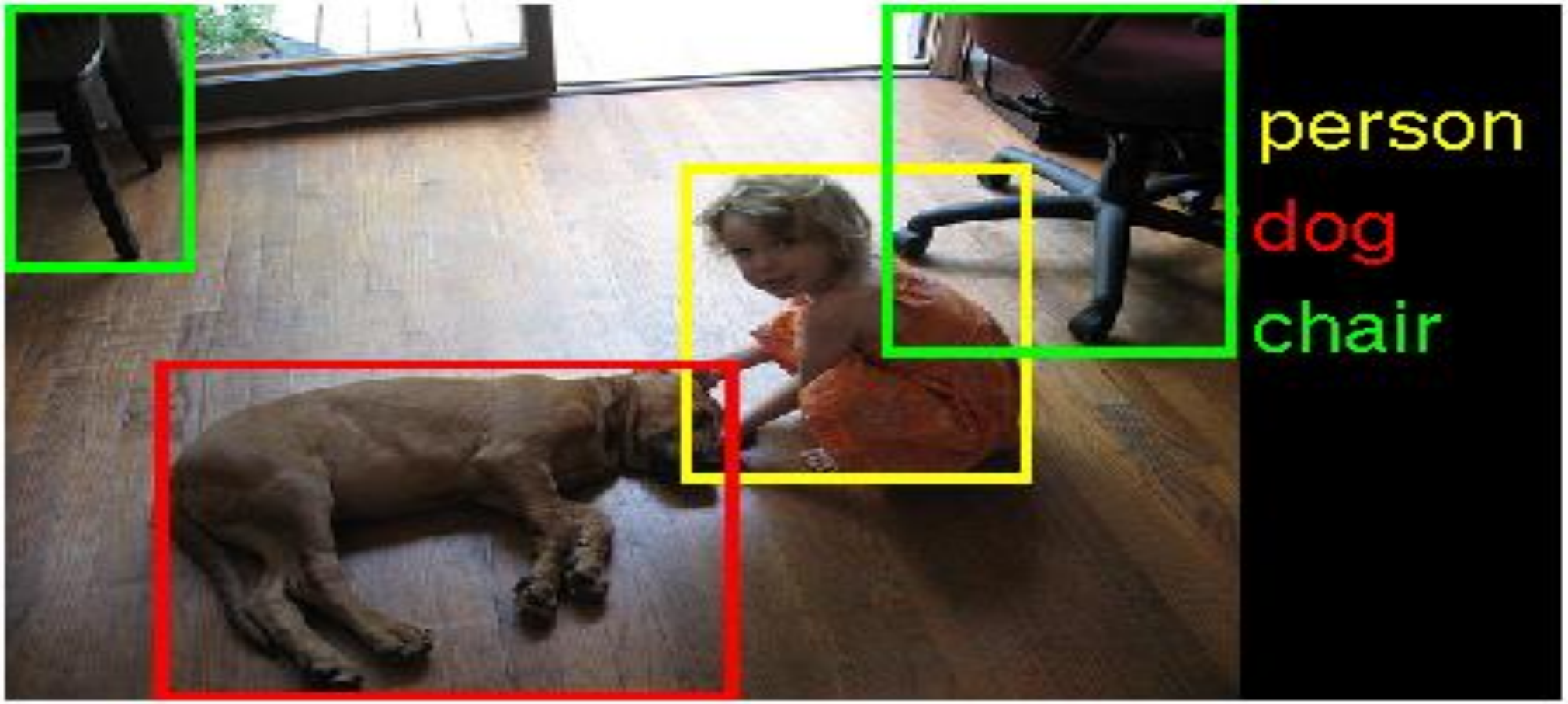


深度学习简介

深度学习简介

搜索词“deep learning”（深度学习）在Google上的热度图

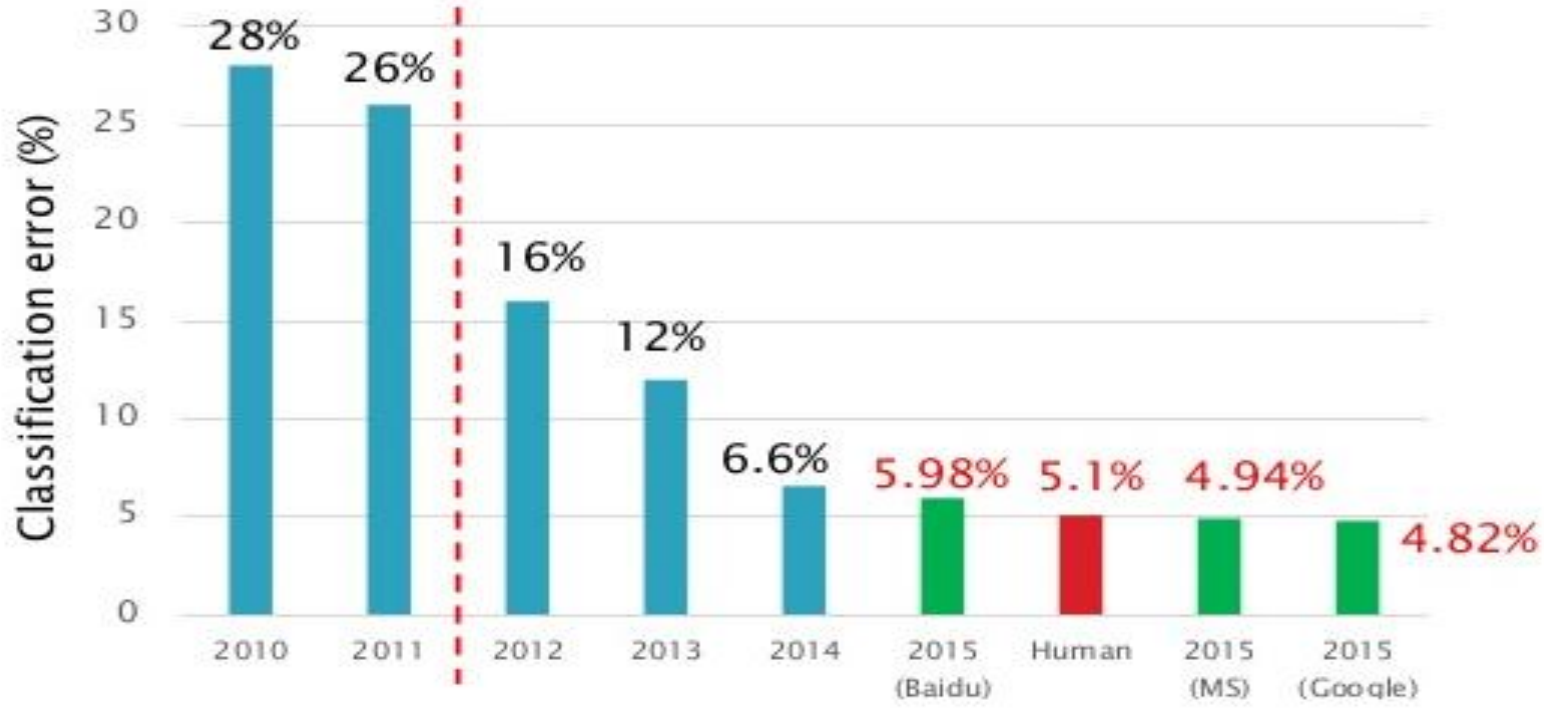
图像识别



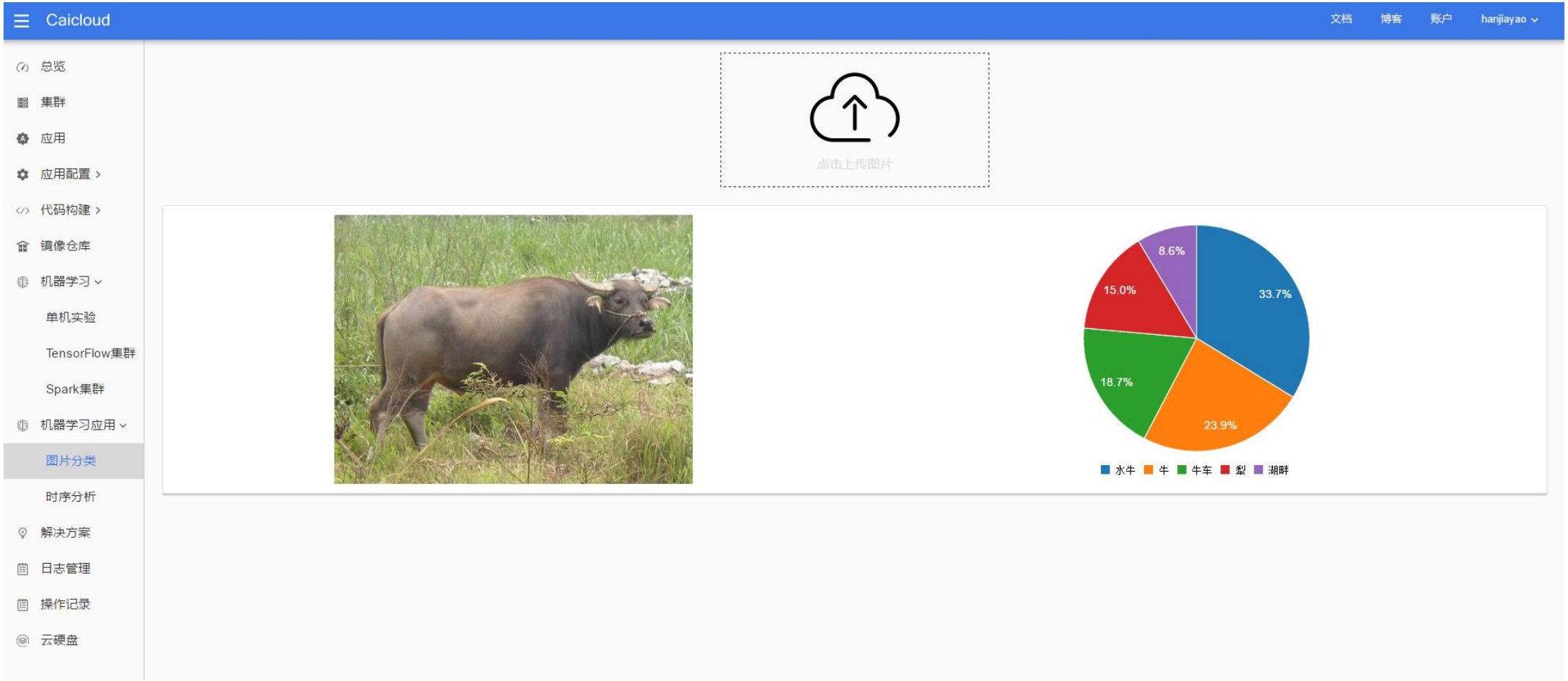
图像识别

深度学习之前

深度学习之后



图像识别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日志管理
操作记录
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点击上传图片
8.6%
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水牛
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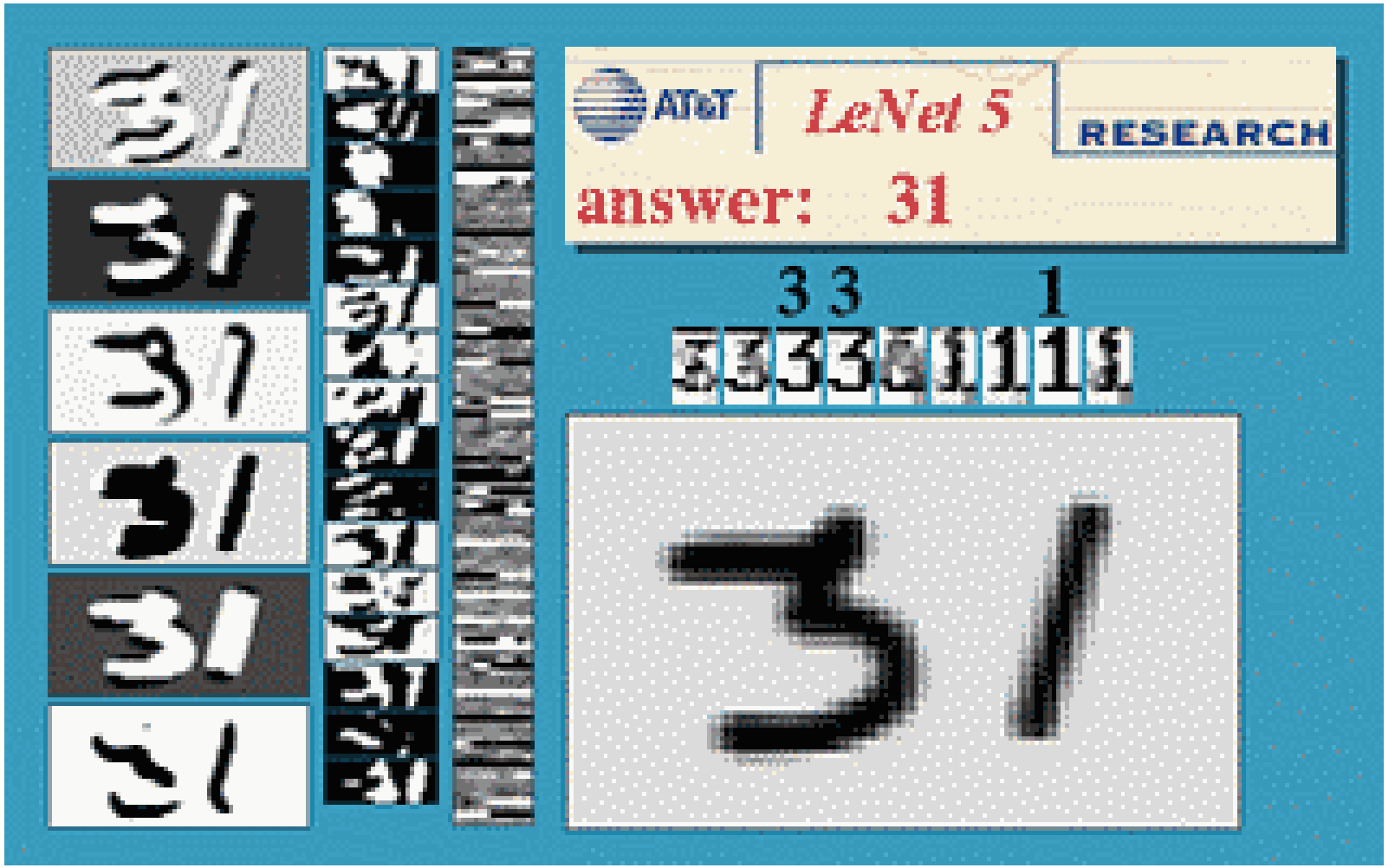
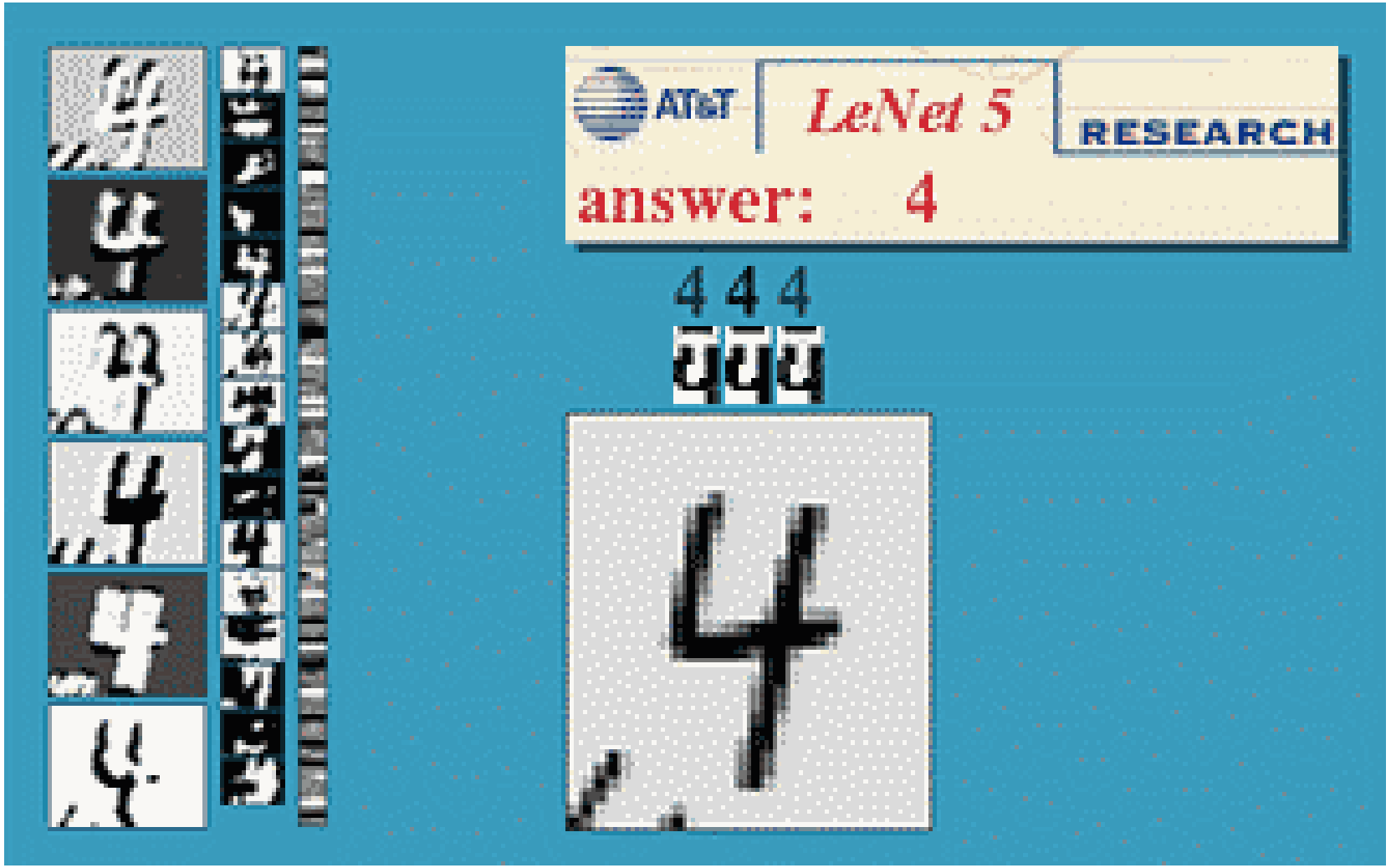
图像识别



图像识别



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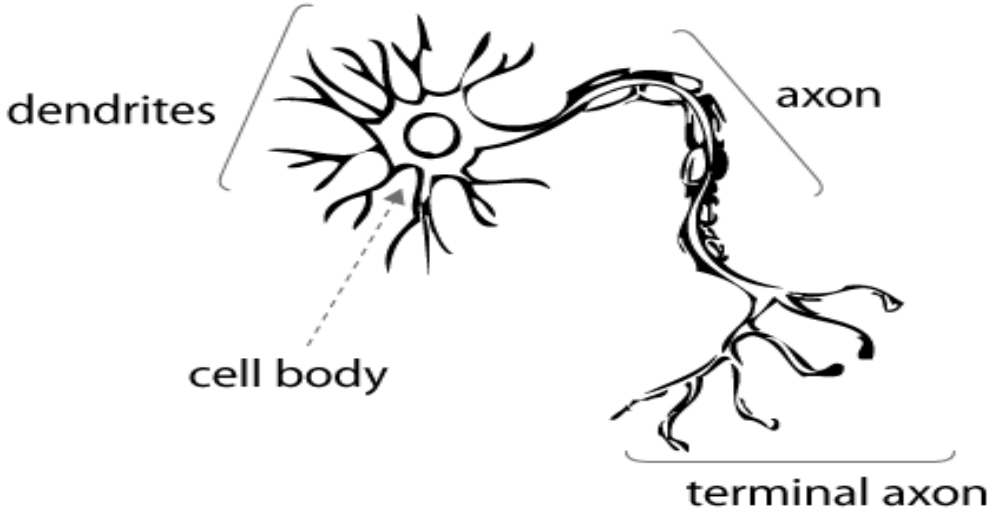
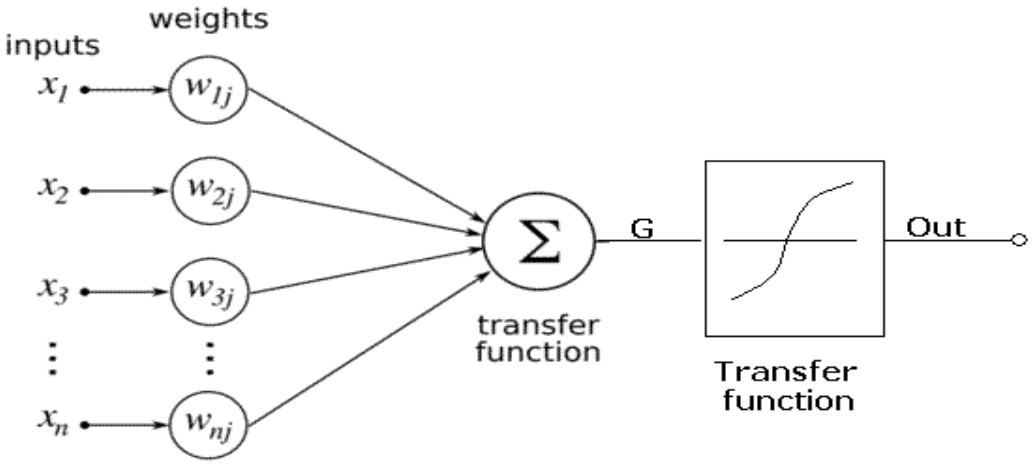
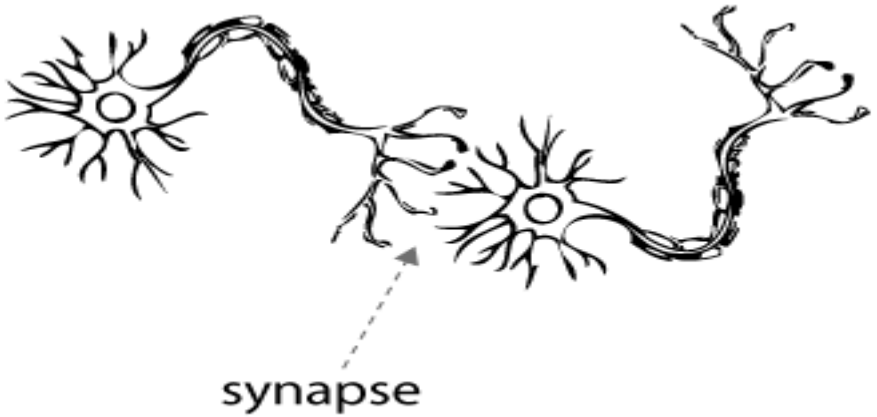
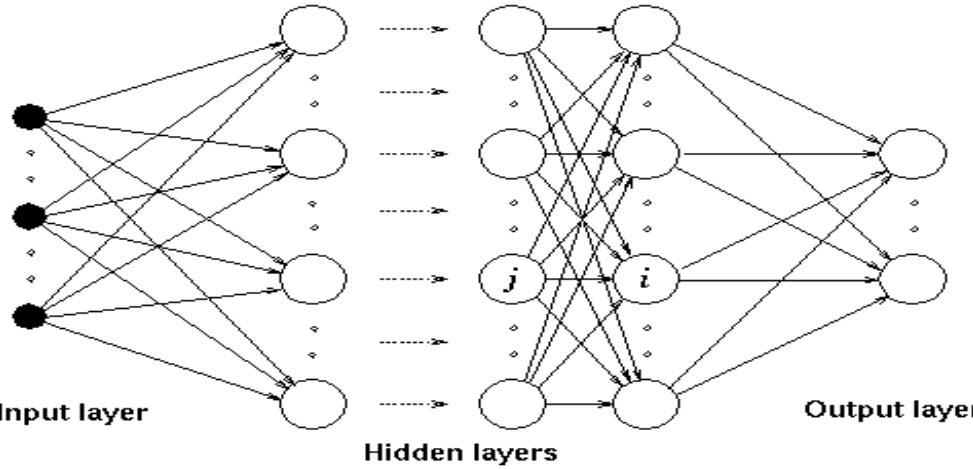

dendrites
axon
cell body
terminal axon

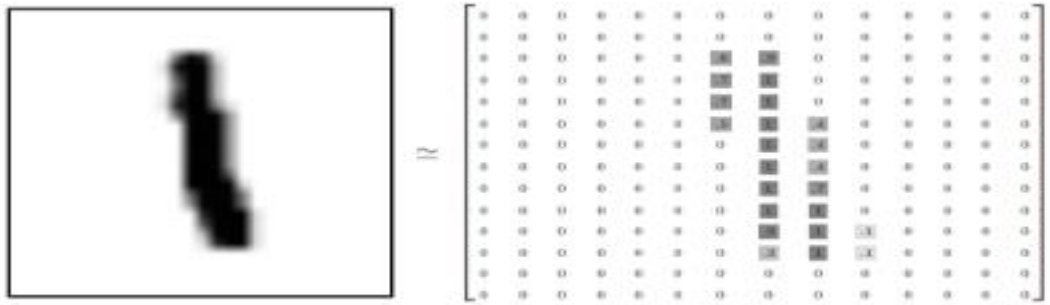

inputs
weights
x_1
x_2
x_3
x_n
w_{1j}
w_{2j}
w_{3j}
w_{nj}
Σ
G
Out
transfer function
Transfer function

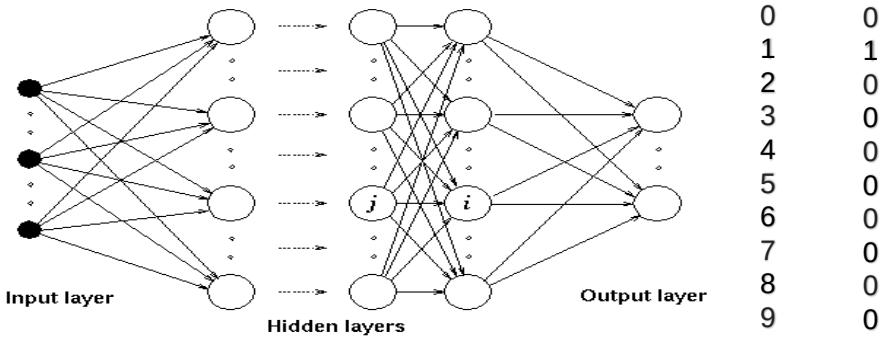

synapse


j
i
Input layer
Hidden layers
Output layer

神经网络模型

图像识别





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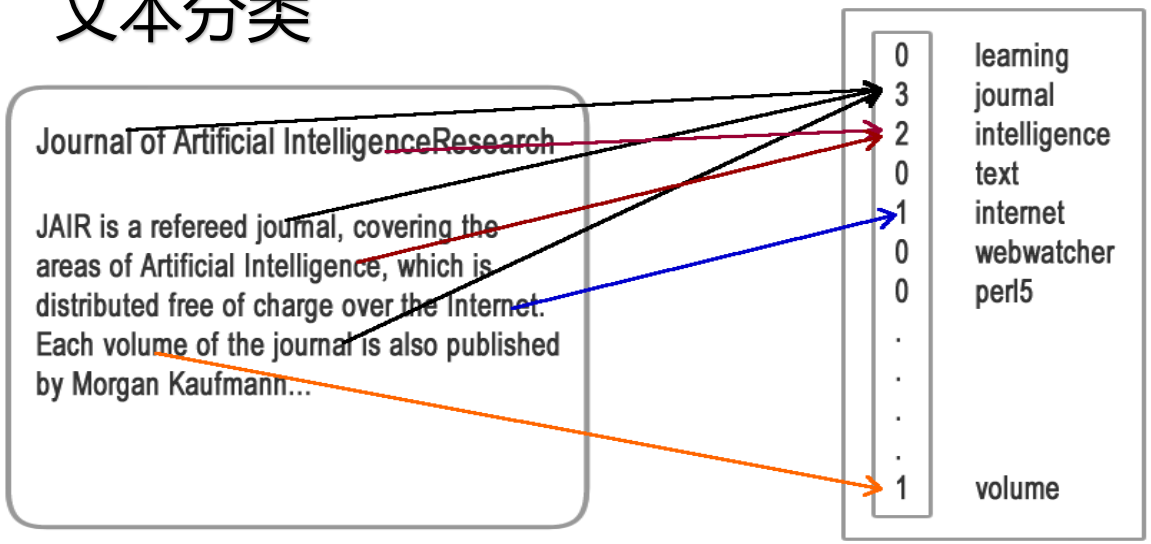
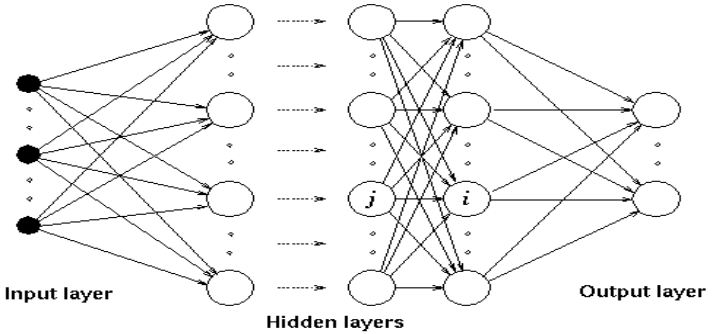
文本分类





👎 0
👍 1

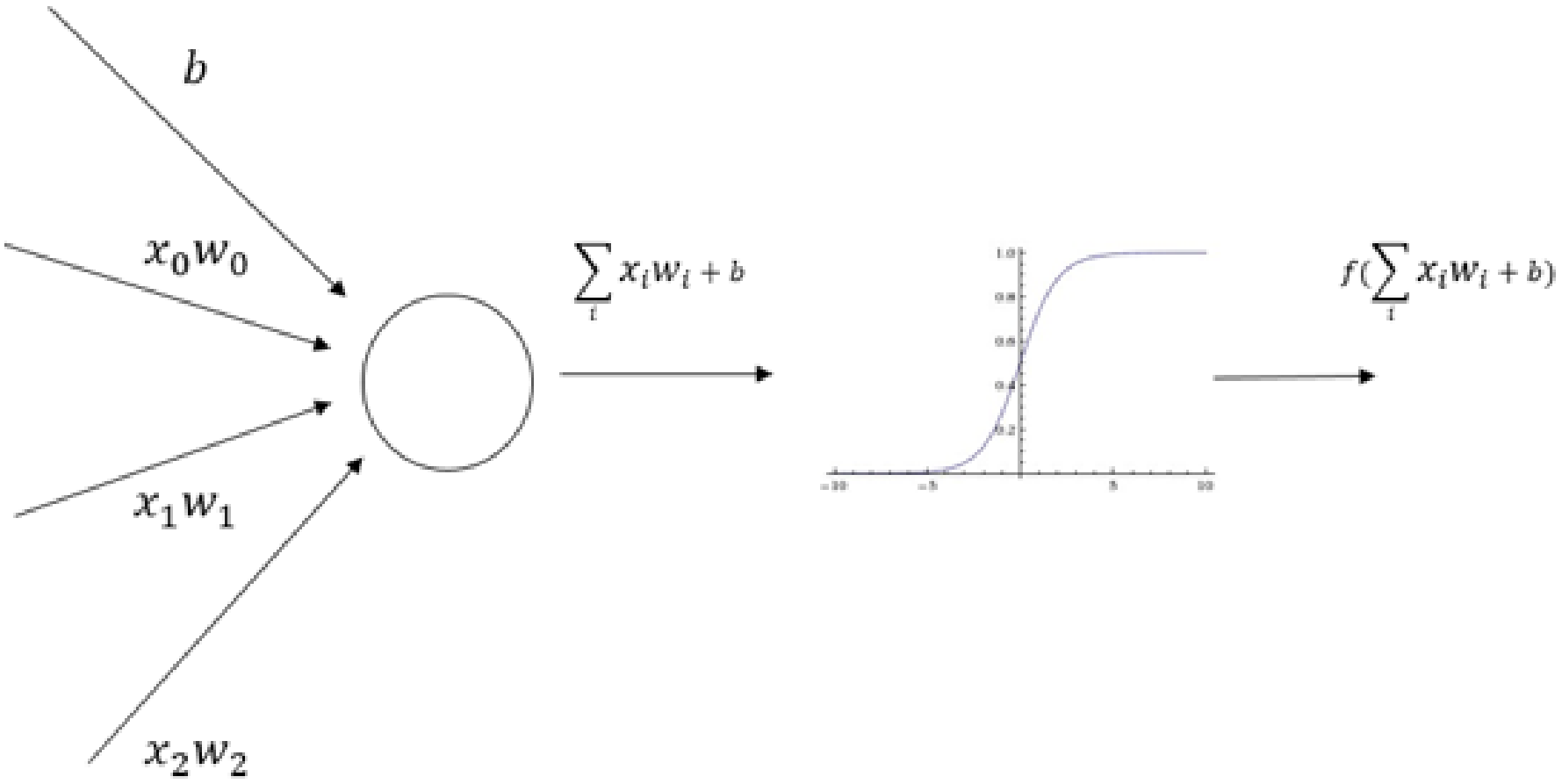
→ 🙂

监督学习和无监督学习

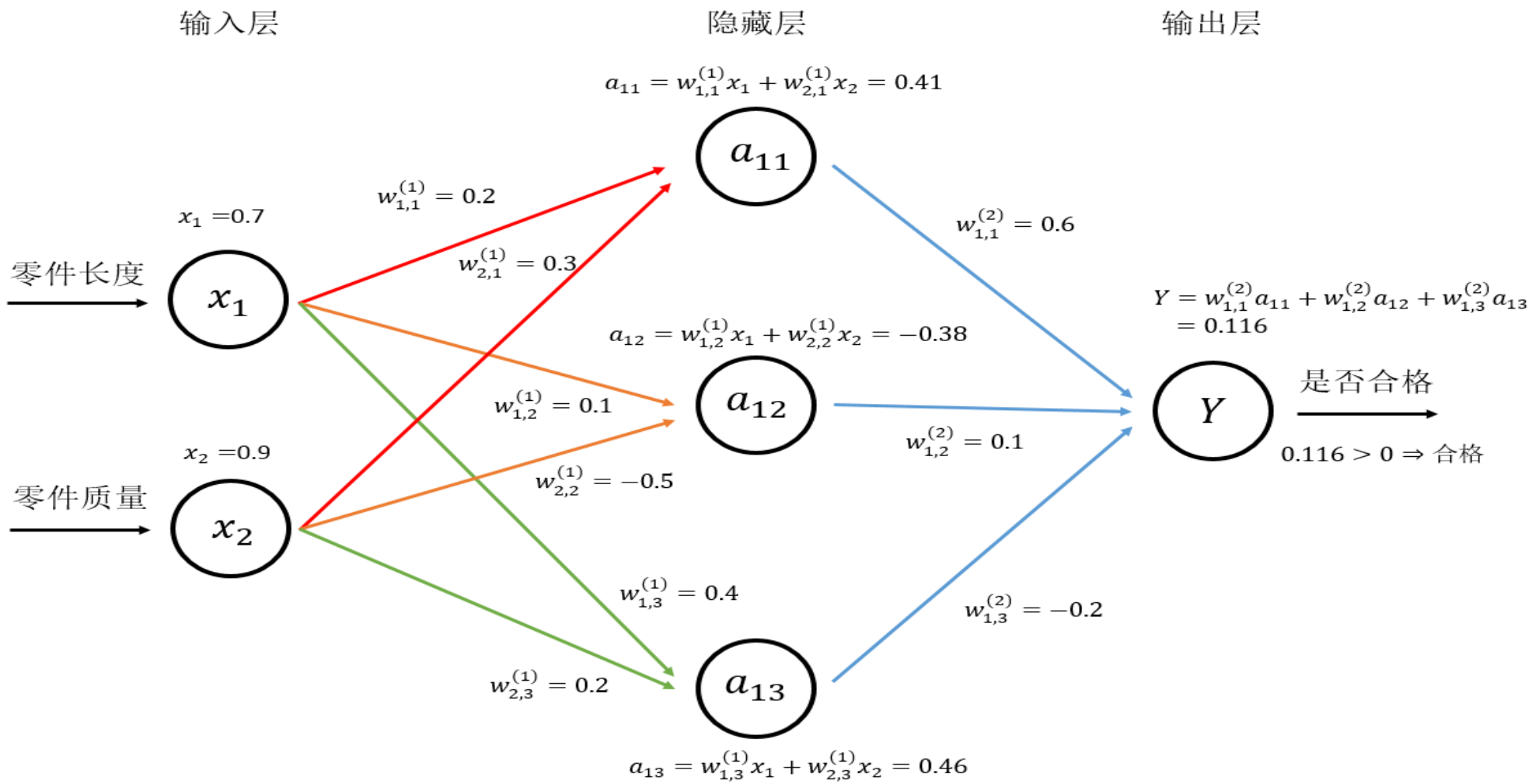
监督式学习（英语：Supervised learning），是一个机器学习中的方法，可以由训练资料中学到或建立一个模式（函数 / learning model），并依此模式推测新的实例。训练资料是由输入物件（通常是向量）和预期输出所组成。函数的输出可以是一个连续的值（称为回归分析），或是预测一个分类标签（称作分类）

非监督式学习是一种机器学习的方式，并不需要人力来输入标签。它是监督式学习和强化学习等策略之外的一种选择。典型的非监督学习有聚类等，直接从数据的特征中寻找相似性。

神经网络模型

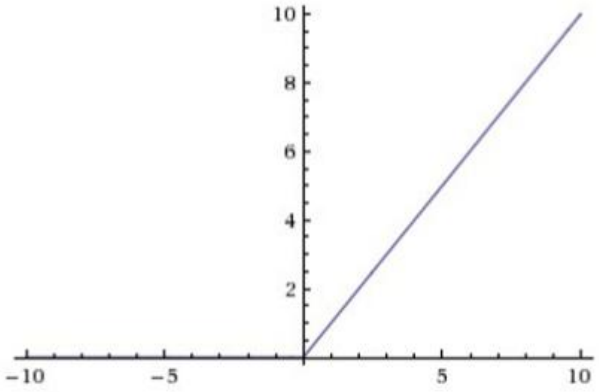


神经网络模型



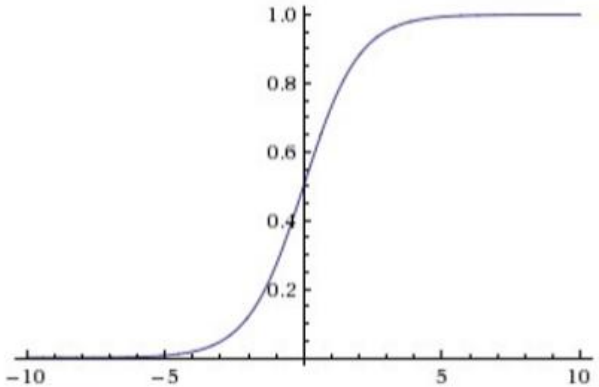
神经网络模型

几种常见的激活函数



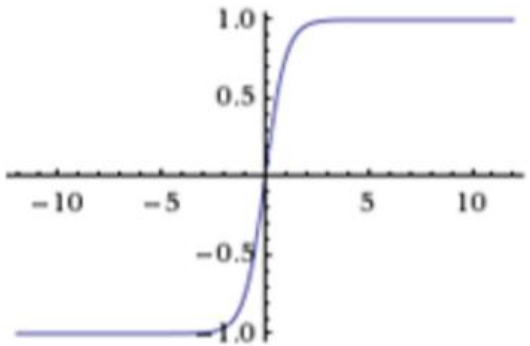
ReLU函数

$f(x) = \max(0, x)$



sigmod 函数

$f(x) = \frac{1}{1+e^{-x}}$



tanh 函数

$f(x) = \frac{1-e^{-2x}}{1+e^{-2x}}$

Softmax激活层: 用于多分类问题

$$softmax(y)_i = y_i' = \frac{e^{y_i}}{\sum_{j=1}^{n} e^{y_j}}$$

假设输出的是$[y_1, y_2, y_3 \cdots y_n]$，经过Softmax回归层后，所有的$y_i$都将被限定在[0, 1]之间， y_i的和是1。

Sigmoid激活层: 用于二分类问题

$$sigmoid(y) = \frac{1}{1+e^{-y}}$$

使用sigmoid解决二分类时一般只有一个输出y。

损失函数: 计算输出和真实标签之间的关系。

1. 交叉熵

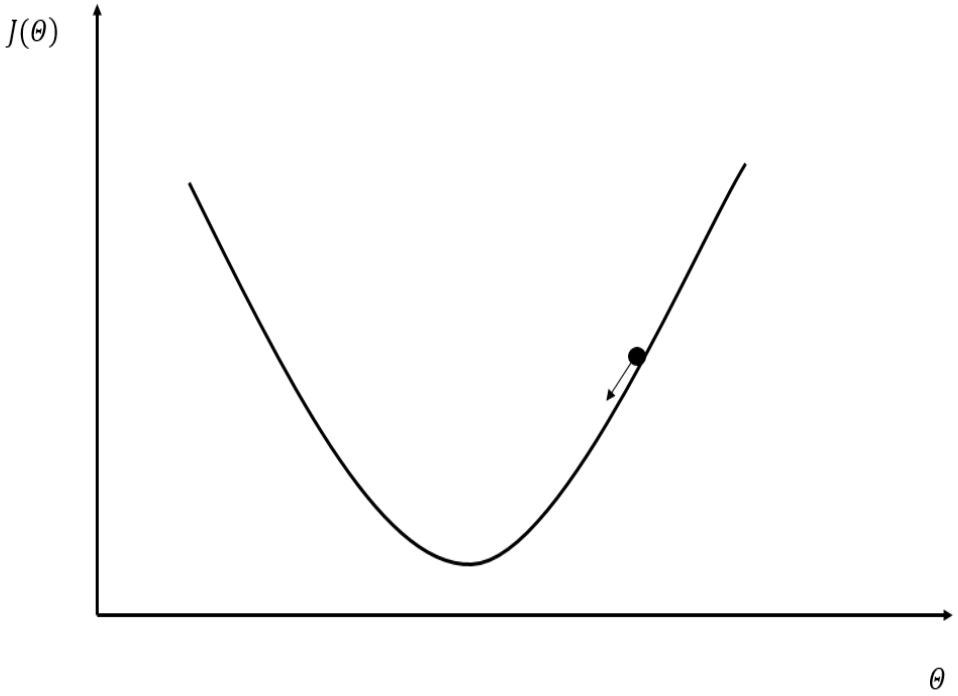
- $H(p,q) = -\sum_x p(x)\, log\, q(x)$
- p是真实的分布，q是模型预测出来的分布。交叉熵是非对称的，描述的是假设一个预测的概率分布q服从的是真实分布p所需要的平均信息量。如果预测的分布q越接近真实的分布p，那么这个信息量就越小。我们所要做的就是优化交叉熵，使其值越小，从而使得模型预测的概率分布越接近真实的概率分布。

2. MSE损失函数：即最小二乘损失函数——描述拟合函数与真实函数之间的误差。

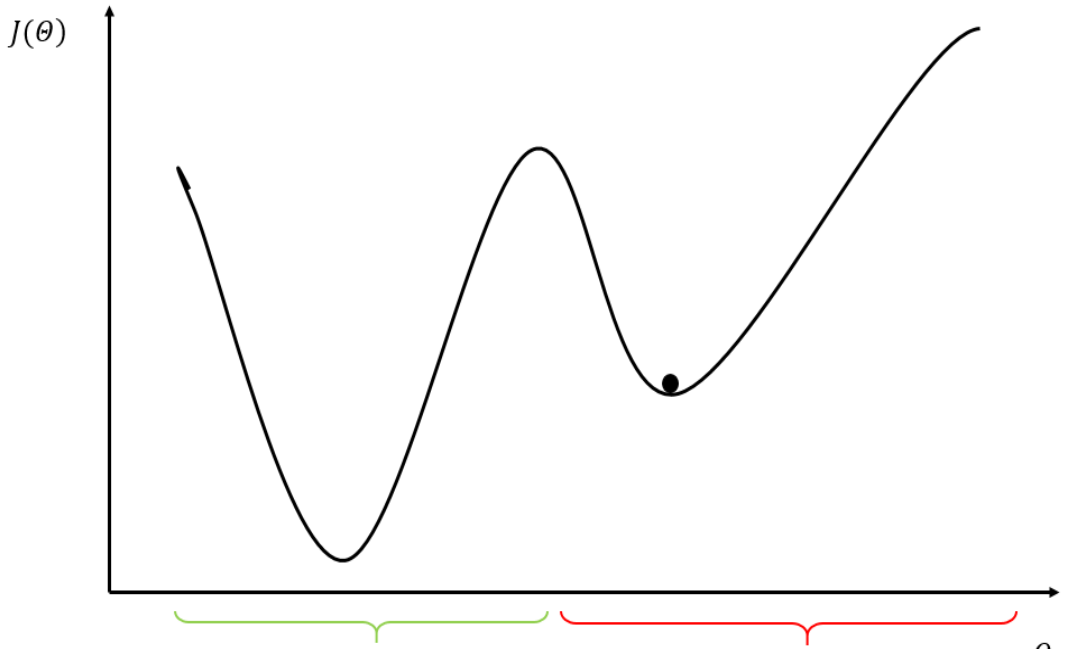
$$L = \frac{1}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)^2$$

3. 自定义损失函数：能够描述预测值与真实值之间的关系。

梯度下降法



最理想的情况，损失函数的
局部最小值就是全局最小值。



一般情况下，损失函数同时存在
局部最小值和全局最小值。这种情况下，
如果上图初始点在右边，
那么迭代会陷入局部点而不能全局收敛。

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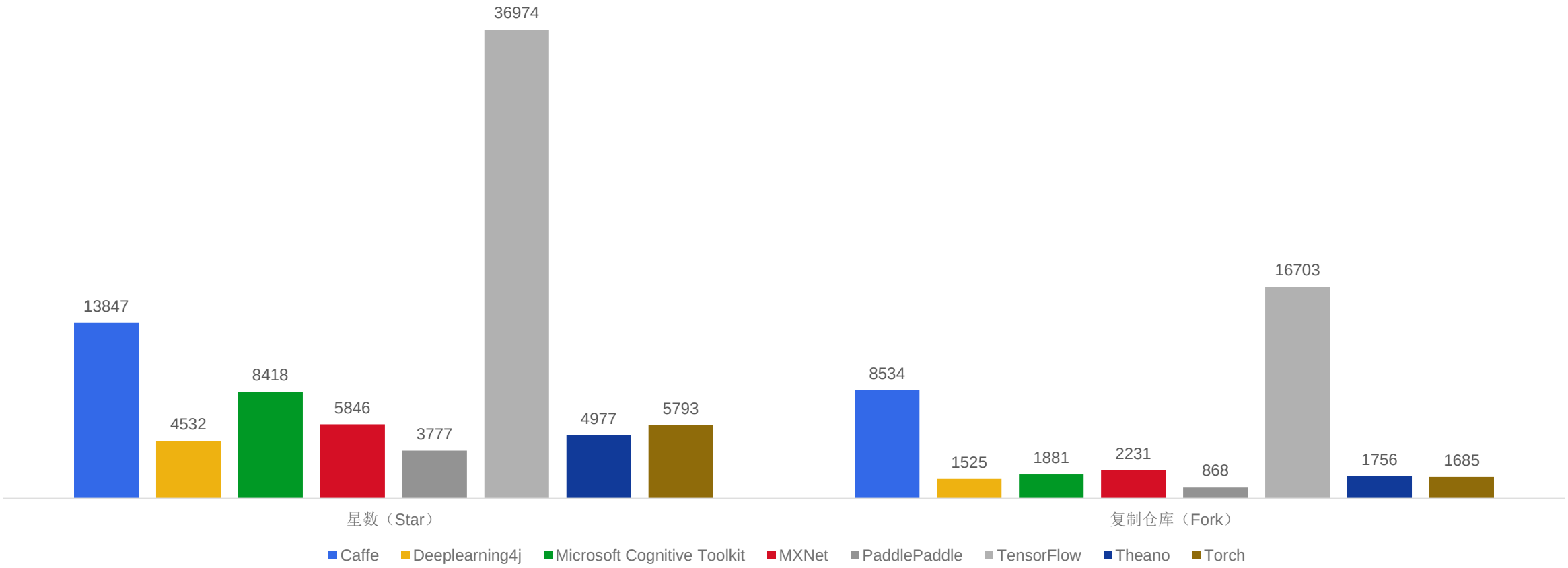
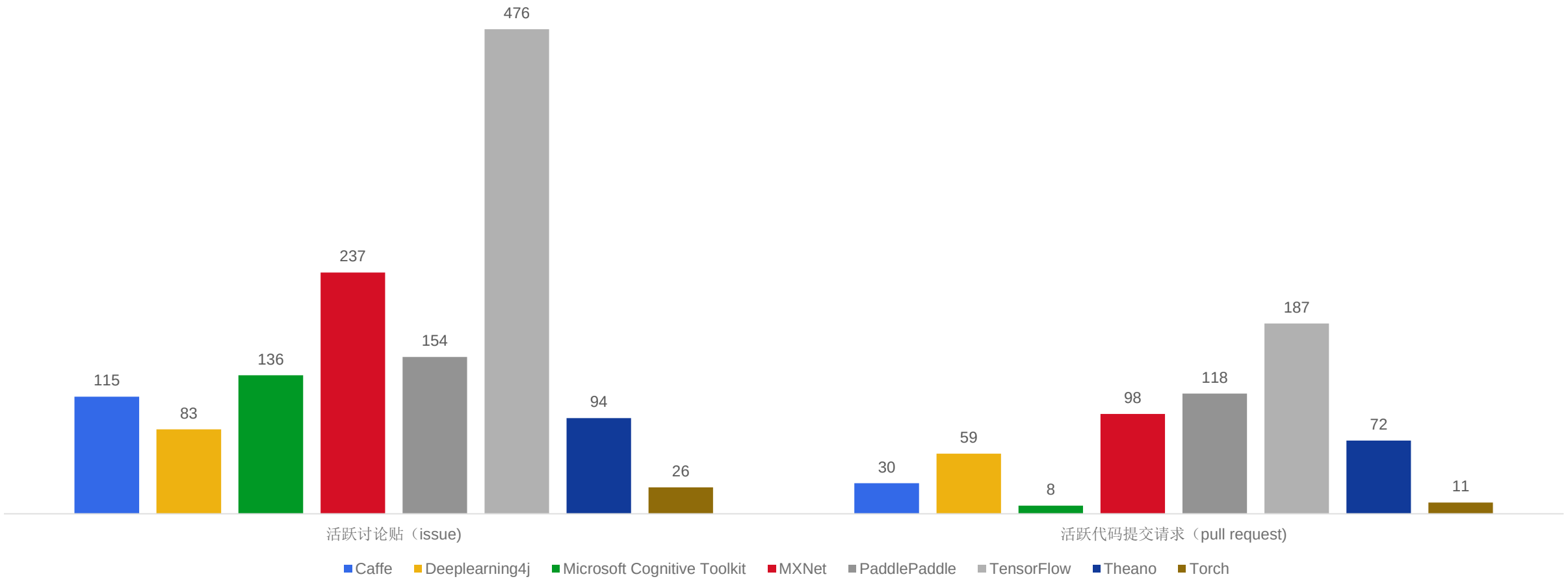
TensorFlow简介

TensorFlow简介



TensorFlow简介



Tensor和Session

TensorFlow里面的变量都以tensor的形式保存，可以调用session来获取tensor的取值

```
import tensorflow as tf
a = tf.constant([1.0, 2.0], name="a")
b = tf.constant([2.0, 3.0], name="b")
result = a + b
print result
```

输出：

```
Tensor("add:0", shape=(2,), dtype=float32)
```

```
with tf.Session() as sess:
  print sess.run(result)
```

输出：

```
[3.0, 5.0]
```

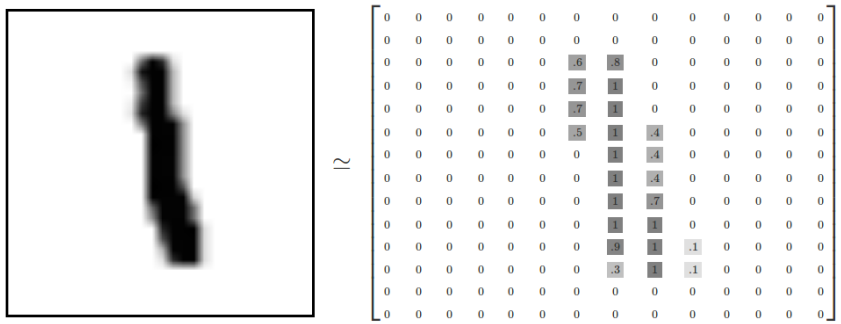
Layer的构建

```
input = tf.placeholder(tf.float32, shape=input_shape, name="input")
w = tf.Variable(tf.random_normal([input_shape, output_shape], stddev=1))
b = tf.Variable(tf.constant(0.1, shape=[output_shape]))
output = tf.nn.relu(tf.matmul(x, w) + b)
```

使用contrib.layers

```
input = tf.placeholder(tf.float32, shape=input_shape, name="input")
output = tf.contrib.layers.fully_connected(input_shape, output_shape, activation_function)
```

MNIST数据集介绍



数字图片及其像素矩阵

1. 读取数据

```
from tensorflow.examples.tutorials.mnist import input_data
mnist = input_data.read_data_sets("../../datasets/MNIST_data/", one_hot=True)
```

```
print "Training data size: ", mnist.train.num_examples
print "Validating data size: ", mnist.validation.num_examples
print "Testing data size: ", mnist.test.num_examples
```

```
Training data size:  55000
Validating data size:  5000
Testing data size:  10000
```

TensorFlow简介

2. 使用next_batch随机划分数据集

```
batch_size = 100
xs, ys = mnist.train.next_batch(batch_size)     # 从train的集合中选取batch_size个训练数据。
print "X shape:", xs.shape
print "Y shape:", ys.shape
```

```
X shape: (100, 784)
Y shape: (100, 10)
```

前向传播

```
def get_weight_variable(shape, regularizer):
    weights = tf.get_variable("weights", shape, initializer=tf.truncated_normal_initializer(stddev=0.1))
    if regularizer != None: tf.add_to_collection('losses', regularizer(weights))
    return weights
```

```
def inference(input_tensor, regularizer):

    #定义第一层
    with tf.variable_scope('layer1'):

        weights = get_weight_variable([INPUT_NODE, LAYER1_NODE], regularizer)
        biases = tf.get_variable("biases", [LAYER1_NODE], initializer=tf.constant_initializer(0.0))
        layer1 = tf.nn.relu(tf.matmul(input_tensor, weights) + biases)

    #定义第二层
    with tf.variable_scope('layer2'):
        weights = get_weight_variable([LAYER1_NODE, OUTPUT_NODE], regularizer)
        biases = tf.get_variable("biases", [OUTPUT_NODE], initializer=tf.constant_initializer(0.0))
        layer2 = tf.matmul(layer1, weights) + biases

    return layer2
```

TensorFlow简介

```
def train(mnist):
    # 定义输入输出placeholder。
    x = tf.placeholder(tf.float32, [None, mnist_inference.INPUT_NODE], name='x-input')
    y_ = tf.placeholder(tf.float32, [None, mnist_inference.OUTPUT_NODE], name='y-input')

    regularizer = tf.contrib.layers.l2_regularizer(REGULARIZATION_RATE)
    y = mnist_inference.inference(x, regularizer)
    global_step = tf.Variable(0, trainable=False)

    # 定义损失函数、学习率、滑动平均操作以及训练过程。
    variable_averages = tf.train.ExponentialMovingAverage(MOVING_AVERAGE_DECAY, global_step)
    variables_averages_op = variable_averages.apply(tf.trainable_variables())
    cross_entropy = tf.nn.sparse_softmax_cross_entropy_with_logits(logits=y, labels=tf.argmax(y_, 1))
    cross_entropy_mean = tf.reduce_mean(cross_entropy)
    loss = cross_entropy_mean + tf.add_n(tf.get_collection('losses'))
    learning_rate = tf.train.exponential_decay(
        LEARNING_RATE_BASE,
        global_step,
        mnist.train.num_examples / BATCH_SIZE, LEARNING_RATE_DECAY,
        staircase=True)
    train_step = tf.train.GradientDescentOptimizer(learning_rate).minimize(loss, global_step=global_step)
    with tf.control_dependencies([train_step, variables_averages_op]):
        train_op = tf.no_op(name='train')

    # 初始化TensorFlow持久化类。
    saver = tf.train.Saver()
    with tf.Session() as sess:
        tf.global_variables_initializer().run()

        for i in range(TRAINING_STEPS):
            xs, ys = mnist.train.next_batch(BATCH_SIZE)
            _, loss_value, step = sess.run([train_op, loss, global_step], feed_dict={x: xs, y_: ys})
            if i % 1000 == 0:
                print("After %d training step(s), loss on training batch is %g." % (step, loss_value))
                saver.save(sess, os.path.join(MODEL_SAVE_PATH, MODEL_NAME), global_step=global_step)
```

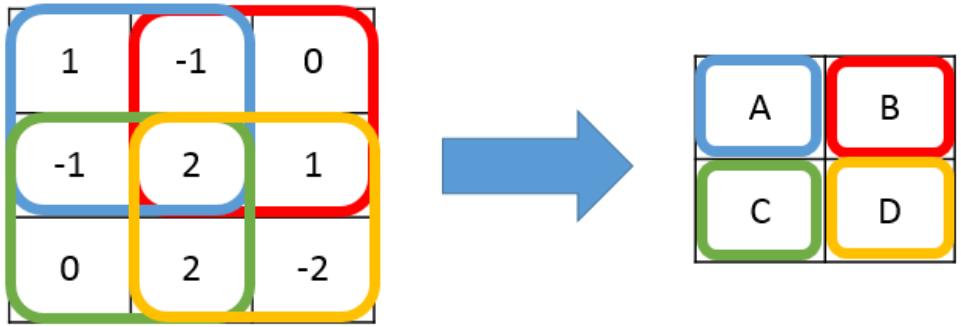
TensorFlow简介

```
def main(argv=None):
    mnist = input_data.read_data_sets("../../../datasets/MNIST_data", one_hot=True)
    train(mnist)

if __name__ == '__main__':
    main()
```

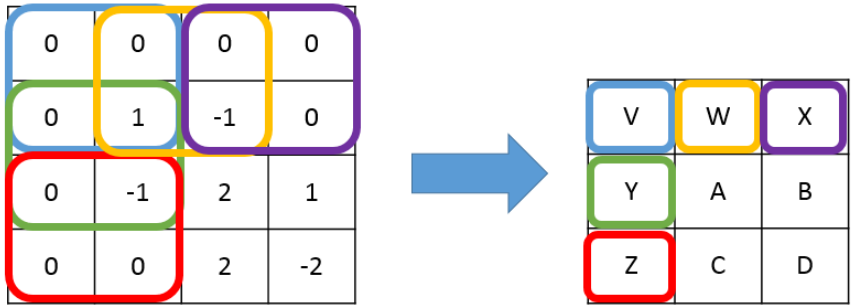
TensorFlow简介

```
# 加载的时间间隔。
EVAL_INTERVAL_SECS = 10

def evaluate(mnist):
    with tf.Graph().as_default() as g:
        x = tf.placeholder(tf.float32, [None, mnist_inference.INPUT_NODE], name='x-input')
        y_ = tf.placeholder(tf.float32, [None, mnist_inference.OUTPUT_NODE], name='y-input')
        validate_feed = {x: mnist.validation.images, y_: mnist.validation.labels}

        y = mnist_inference.inference(x, None)
        correct_prediction = tf.equal(tf.argmax(y, 1), tf.argmax(y_, 1))
        accuracy = tf.reduce_mean(tf.cast(correct_prediction, tf.float32))

        variable_averages = tf.train.ExponentialMovingAverage(mnist_train.MOVING_AVERAGE_DECAY)
        variables_to_restore = variable_averages.variables_to_restore()
        saver = tf.train.Saver(variables_to_restore)

        while True:
            with tf.Session() as sess:
                ckpt = tf.train.get_checkpoint_state(mnist_train.MODEL_SAVE_PATH)
                if ckpt and ckpt.model_checkpoint_path:
                    saver.restore(sess, ckpt.model_checkpoint_path)
                    global_step = ckpt.model_checkpoint_path.split('/')[-1].split('-')[-1]
                    accuracy_score = sess.run(accuracy, feed_dict=validate_feed)
                    print("After %s training step(s), validation accuracy = %g" % (global_step, accuracy_score))
                else:
                    print('No checkpoint file found')
                    return
            time.sleep(EVAL_INTERVAL_SECS)
```

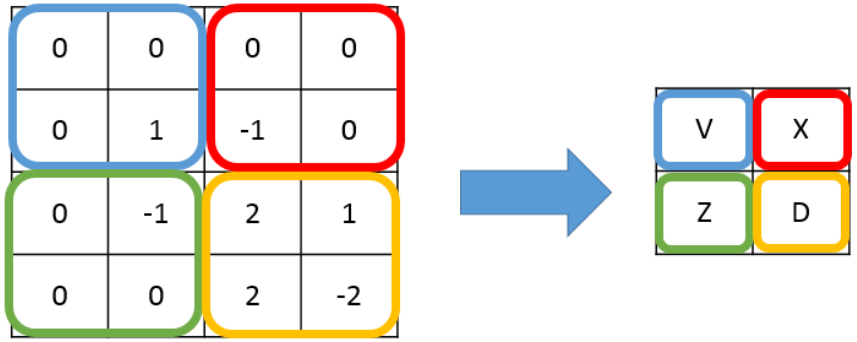
卷积神经网络



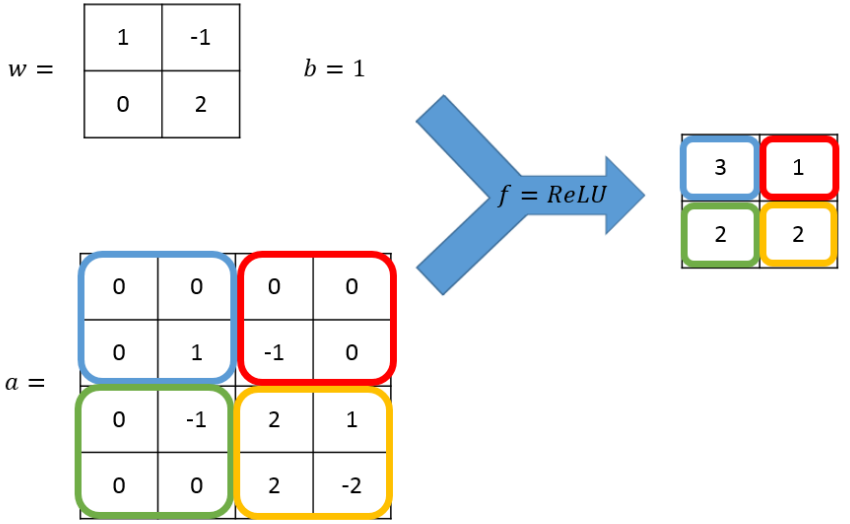
卷积层 前向传播



使用全0填充



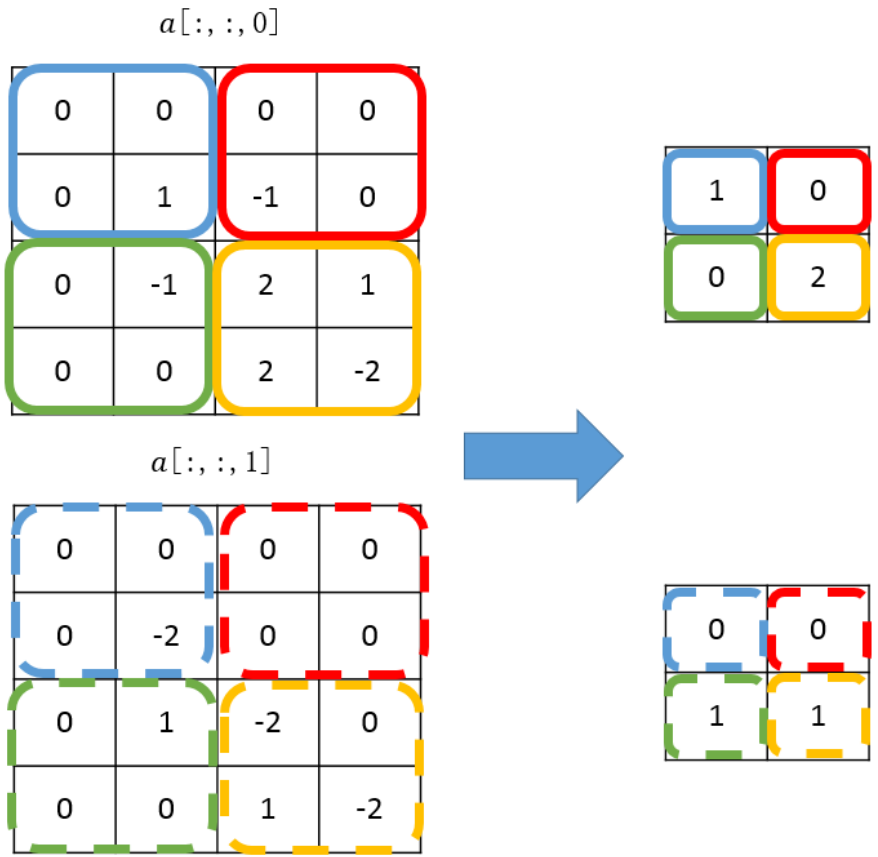
移动步长为2



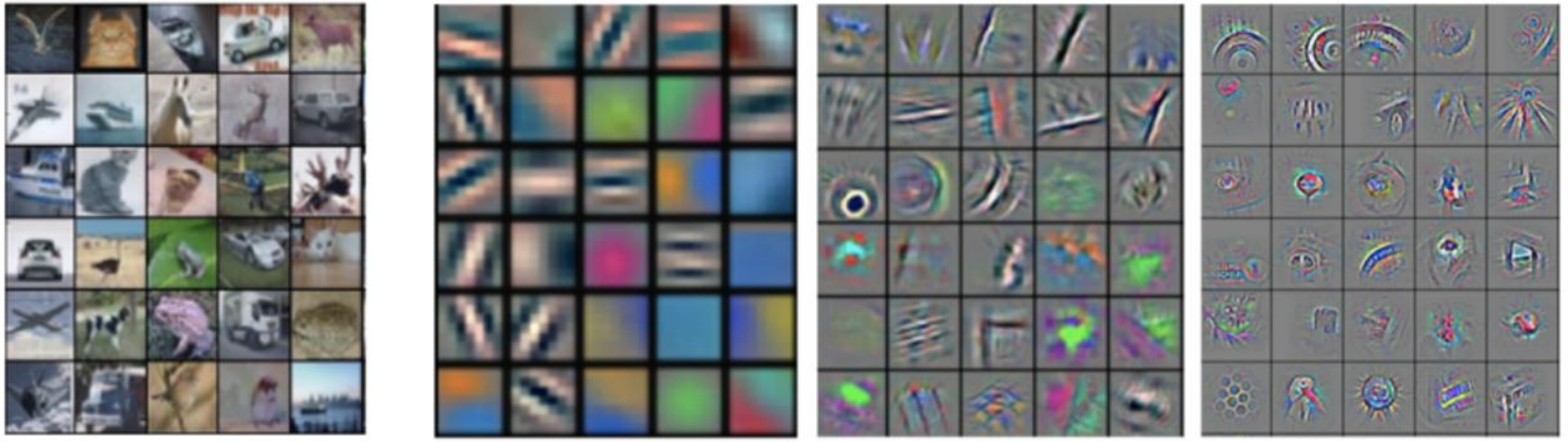
使用全0填充

池化

池化一般分为最大池化层（max pooling），
平均池化层（average pooling）

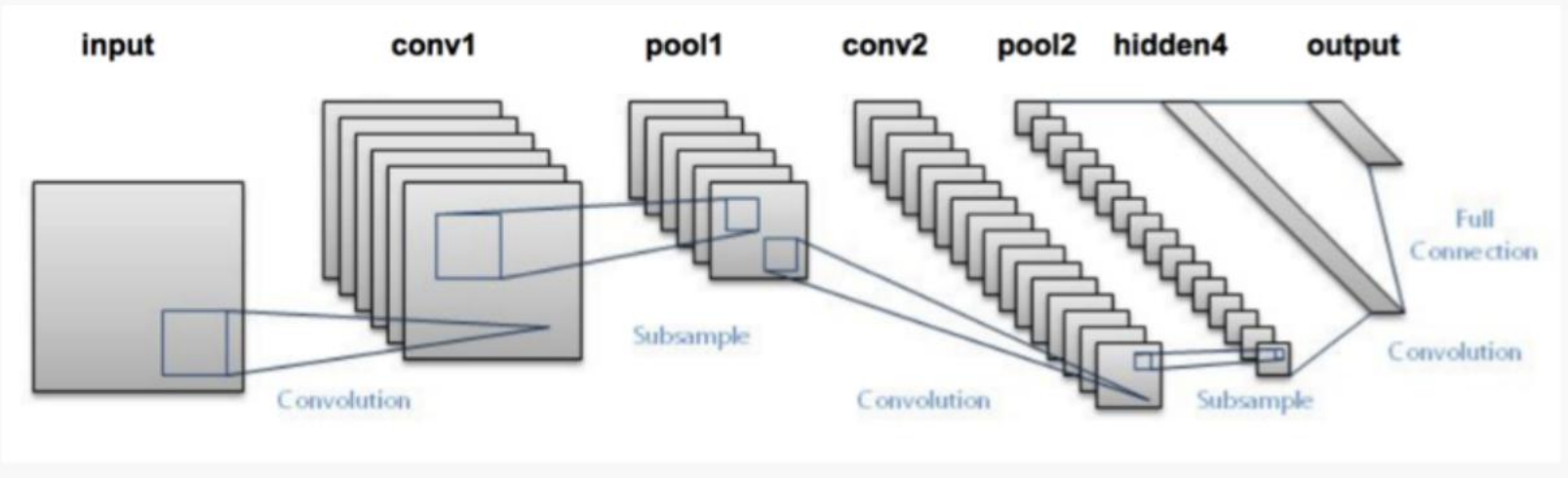


卷积相当于提取图像的特征



基础特征：图片像素　　第一层：线条　　第二层：简单形状　　第三层：复杂形状

LeNet5模型（前向传播）



input →卷积1 →池化1 →卷积2 →池化2 → 全连接1 → 全连接1 → output

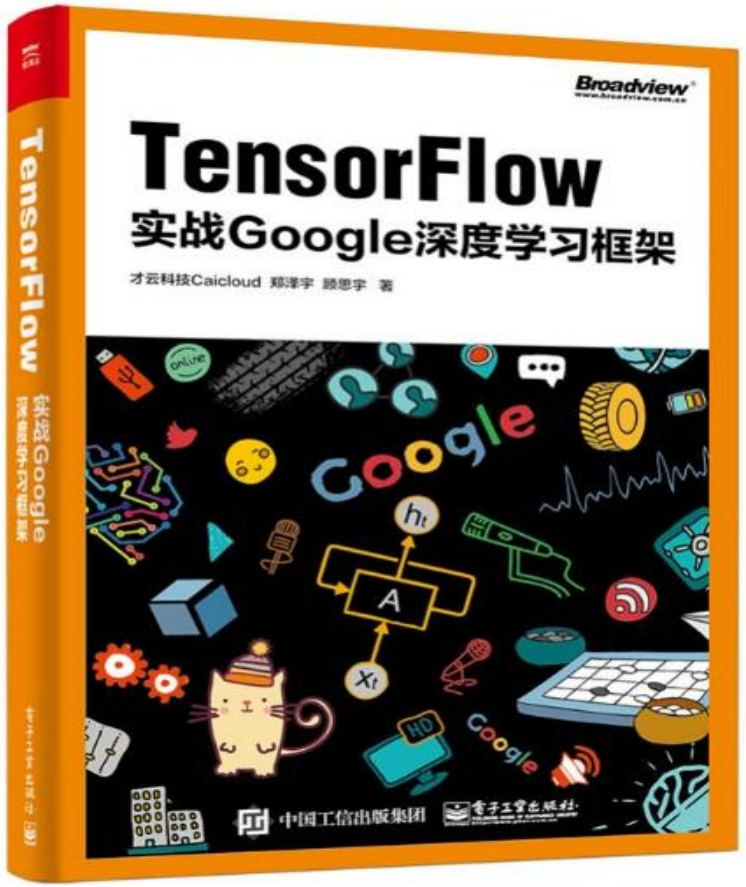
卷积神经网络

```
def inference(input_tensor, train, regularizer):
    with tf.variable_scope('layer1-conv1'):
        conv1_weights = tf.get_variable(
            "weight", [CONV1_SIZE, CONV1_SIZE, NUM_CHANNELS, CONV1_DEEP],
            initializer=tf.truncated_normal_initializer(stddev=0.1))
        conv1_biases = tf.get_variable("bias", [CONV1_DEEP], initializer=tf.constant_initializer(0.0))
        conv1 = tf.nn.conv2d(input_tensor, conv1_weights, strides=[1, 1, 1, 1], padding='SAME')
        relu1 = tf.nn.relu(tf.nn.bias_add(conv1, conv1_biases))

    with tf.name_scope("layer2-pool1"):
        pool1 = tf.nn.max_pool(relu1, ksize = [1,2,2,1],strides=[1,2,2,1],padding="SAME")

    with tf.variable_scope("layer3-conv2"):
        conv2_weights = tf.get_variable(
            "weight", [CONV2_SIZE, CONV2_SIZE, CONV1_DEEP, CONV2_DEEP],
            initializer=tf.truncated_normal_initializer(stddev=0.1))
        conv2_biases = tf.get_variable("bias", [CONV2_DEEP], initializer=tf.constant_initializer(0.0))
        conv2 = tf.nn.conv2d(pool1, conv2_weights, strides=[1, 1, 1, 1], padding='SAME')
        relu2 = tf.nn.relu(tf.nn.bias_add(conv2, conv2_biases))

    with tf.name_scope("layer4-pool2"):
        pool2 = tf.nn.max_pool(relu2, ksize=[1, 2, 2, 1], strides=[1, 2, 2, 1], padding='SAME')
        pool_shape = pool2.get_shape().as_list()
        nodes = pool_shape[1] * pool_shape[2] * pool_shape[3]
        reshaped = tf.reshape(pool2, [pool_shape[0], nodes])
```

卷积神经网络

```
with tf.variable_scope('layer5-fc1'):
    fc1_weights = tf.get_variable("weight", [nodes, FC_SIZE],
                                  initializer=tf.truncated_normal_initializer(stddev=0.1))
    if regularizer != None: tf.add_to_collection('losses', regularizer(fc1_weights))
    fc1_biases = tf.get_variable("bias", [FC_SIZE], initializer=tf.constant_initializer(0.1))

    fc1 = tf.nn.relu(tf.matmul(reshaped, fc1_weights) + fc1_biases)
    if train: fc1 = tf.nn.dropout(fc1, 0.5)

with tf.variable_scope('layer6-fc2'):
    fc2_weights = tf.get_variable("weight", [FC_SIZE, NUM_LABELS],
                                  initializer=tf.truncated_normal_initializer(stddev=0.1))
    if regularizer != None: tf.add_to_collection('losses', regularizer(fc2_weights))
    fc2_biases = tf.get_variable("bias", [NUM_LABELS], initializer=tf.constant_initializer(0.1))
    logit = tf.matmul(fc1, fc2_weights) + fc2_biases

return logit
```

TensorFlow简介



https://item.jd.com/12125572.html?dist=jd

https://github.com/caicloud/tensorflow-tutorial

Caicloud

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谢谢大家！